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## Update on the CCI Adhesive Tape and Heat-Set Tissues Project

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### Abstract

This paper reports on some properties of various adhesive tapes and heat-set tissues that were tested to help understand their stability and impact on paper. The tested properties include:

- pH of fresh products
- colour change of the products (carrier side) and of the paper substrates to which they were attached (reverse side) after thermal aging
- photographic activity test (PAT)
- mechanical and solvent removal of the products from 1870s commercial printing paper and resin-coated photographic (RC) paper before and after thermal aging and after 1 year of dark aging

Only one product discoloured the paper substrate on the reverse significantly after thermal aging, but several product carriers discoloured substantially. Only 40% of the products passed the PAT. Fresh products were generally neutral, but a few were slightly alkaline or acidic. Generally, products were easier to remove from the RC paper than from the 1870s commercial printing paper. Aging tended to decrease removability, although several products did not change drastically on aging. A discussion of the results identifies a few products that have scored well overall so far, but aging continues and results must be considered in this light.

### Titre et Résumé

#### État du projet de l’ICC sur les rubans adhésifs et les papiers de soie fixés à chaud

Le présent article traite de certaines propriétés de divers rubans adhésifs et papiers de soie fixés à chaud qui ont été mis à l’essai afin de mieux comprendre leur stabilité et leurs effets sur le papier. Les propriétés mises à l’essai comprenaient, entre autres, les suivantes :

- le pH des produits neufs;
- l’altération de la couleur des produits (du côté support) et des substrats de papier auxquels ils sont fixés (le verso), après le vieillissement thermique;
- l’essai d’activité photographique (EAP);
- l’enlèvement mécanique et l’enlèvement au moyen d’un solvant des produits présents sur du papier d’impression commercial datant des années 1870 et du papier photographique plastifié (papier RC), avant et après vieillissement thermique, et après un an de vieillissement dans le noir.

Un seul produit a provoqué une importante altération de la couleur du verso du substrat de papier, après le vieillissement thermique, mais plusieurs supports de produits ont subi une altération appréciable de la couleur. Seuls 40 % des produits ont réussi l'essai d'activité photographique. Les produits neufs sont généralement neutres, mais quelques-uns sont légèrement alcalins ou acides. De manière générale, il est plus facile d'enlever les produits fixés sur du papier RC que ceux fixés sur du papier d'impression commercial des années 1870. Le vieillissement a tendance à réduire la facilité d'enlèvement des produits, mais plusieurs d'entre eux ne subissent pas d'altération grave après ces traitements. La discussion portant sur les résultats permet d'identifier quelques produits qui ont jusqu'ici donné des bons résultats globaux, mais les traitements de vieillissement se poursuivent et l'interprétation des données doit en tenir compte.

## Introduction

Commercial adhesive tapes are not usually recommended for archival applications but, given the enormous volume in use by the general public, they will inevitably find their way into museum and archival collections. Thus, research into their properties and removability is important. Heat-set tissues (HST), on the other hand, are frequently used in conservation treatments, but not without questions about suitability and safety.

In 2001, the Canadian Conservation Institute (CCI) began a project on tapes and heat-set tissues (THST). The purpose of the project was to study the chemical, mechanical, and removability properties of THST so as to understand their impact on paper and to develop a reliable system for comparative evaluation. A program of research, which included a screening program to reduce the number of products to test in a larger testing program, was devised.

## Screening Program

The screening program was carried out in 2005 (Down et al. 2006) and involved the following steps:

- collection of 146 THST
- identification of major components by Fourier transform infrared (FTIR) spectroscopy
- measurement of composite pH (carrier+adhesive) (ASTM Standard D1583-01 2001)
- tabulation of results and selection of 44 products that did not:
  - contain poly(vinyl chloride) (PVC), rubber, rosin, or styrene butadiene
  - have a pH less than 6 or more than 8
  - have a colour

(however, token products containing PVC, rubber, rosin, or styrene butadiene, and one black tape were included as possible worst-case scenarios for comparison purposes)

When preparations for further testing began in 2009, fresh products were ordered and analysed by FTIR to ensure that they were identical to the original products selected in 2005. A few products showed differences, but these were fairly slight. Ten products were no longer available, so were either deleted from the program or substituted with similar products. Also, a few new products were added. The final list of 42 products selected in 2009 for further testing is given in Table 1.

## Testing Program

The original testing plan included many tests (Down et al. 2006), but only the following assessments are reported here:

- a) composite **pH** on natural dark aging (NDA) [only controls reported here]
- b) **colour change** after NDA and oven aging [only oven aging reported here]
- c) damage to photographs using a **photographic activity test** (PAT) on unaged samples only
- d) **removability** of the THST after NDA and oven aging [only controls, 1 year NDA, and oven aging reported here]

The oven aging conditions were 80°C, 65% relative humidity (RH) for 28 days (ISO 5630/3 1986). NDA was carried out at CCI at ambient conditions (22°C, 45% RH).

### Preparation of heat-set and remoistenable tissues

Procedures to prepare the heat-set and remoistenable tissues were as follows:

- The wet adhesive was spread with a glass microscope slide onto thick Mylar where wells (5 × 25 cm) were made using 3M Magic Tape. This produced an even film with fairly constant thickness. Before the adhesive dried, the Magic Tape was removed and strips of Kurotani tissue were carefully laid on top of the wet adhesive from end to top. Bubbles (if any) were eliminated with very light finger pressure. Once dry, the tissues were cut to the desired width and peeled off the Mylar just before being attached to the substrate either by moistening with distilled water (or ethanol if solvent-reactivated) or by tacking lightly at either end with a heated spatula and then heat-set in a Dritac 3442 Electro Laminating Press (Beckgreyltd., London, England) for 3 minutes. The HST were heat-set at temperatures indicated in Table 1.
- The Library of Congress (LoC) HST were made with Rhoplex AC73, Plextol B500, and distilled water (1.5:1:1) according to the procedure by Hey and Waters (1977). This involved applying the adhesive with a wide Japanese brush onto Mylar and laying Kurotani tissue on top (laid in the middle first, then each end of the tissue was slowly lowered to avoid bubbles).
- Super 77 spray adhesive was applied directly to the substrates using a Mylar cut-out template (2 × 25 cm) which was placed over the substrate. The spray can was held about 20 cm from the substrate/template while spraying. Two passes with the spray were made at a slow steady speed and then the template was removed leaving a strip of adhesive.

### pH

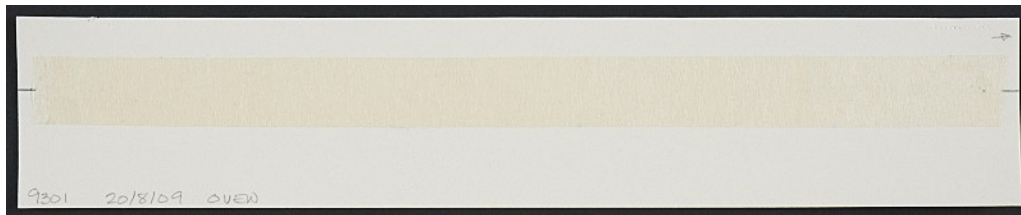
A modified pH standard (ASTM Standard D1583-01 2001; Down et al. 1996) was used to measure the cold water extracted composite pH (adhesive+carrier) of the control samples (0 hours). As several heat-set and remoistenable tissues were prepared using the Kurotani tissue, the pH of the dried adhesive alone and with tissue was measured. The pH of NDA samples (taken in the future) will be compared to these controls (see Table 1).

### *pH results*

For this control set, the majority of the products were in the neutral range (6–8). However, a few (Perforated White Linen Tape, Framers Tape II #S2000, Frame Sealing Tape FST 1000, filmoplast R) were slightly more alkaline (>8), and some (Double-coated Film Tape #415, filmomatt libre, filmolux 609, Scotch Magic Tape #810, LoC adhesive alone, Unsupported Archibond) were slightly more acidic (<6).

### **Colour change**

Samples for colour change were prepared using “Windsor” paper (acidic off-set paper, with alum-rosin sizing, no lignin) manufactured by Domtar (henceforth called “Domtar paper”) (Kaminska and Burgess 1994). Strips (2 × 25 cm) of each THST were laid on the Domtar paper. If the product was a remoistenable tissue, double-sided product, spray, or handmade HST, Kurotani tissue was applied on top and was considered as a carrier. Prior to aging, a control colour measurement was taken on the tape carrier side (henceforth called “tape side”) (Figure 1) as well as the reverse of the Domtar paper in the same location where the adhesive of the THST meets the Domtar paper (henceforth called the “paper side”) (Figure 2). Half of the samples were oven aged and remeasured. The remaining samples were left in the dark aging room for NDA and will be measured in the future for colour change. Colour measurements were taken using a Minolta CM-2600d spectrophotometer. Brightness, Yellowness Index, and Lab measurements were recorded. Only the Lab  $\Delta E^*ab$  measurements (i.e. colour change, henceforth called  $\Delta E$ ) will be discussed here (Table 1) (ASTM Standard D2244-05 2006). Generally, it is agreed that if  $\Delta E$  is 1 or 2, then the colour change is perceptible to the eye (depending on the colour of the object in question and illumination, etc.), and if  $\Delta E > 5$ , then the colour change is substantial (Agosten 1987; Fundamentals 2006; Has 2011).



*Figure 1. Example of colour change sample — tape side.*



Figure 2. Example of colour change sample — paper side.

### *Colour change results*

Paper side:  $\Delta E$  for the Domtar paper after oven aging was  $6.57 \pm 0.07$ , representing a substantial visible colour change. This value was subtracted from all paper-side  $\Delta E$  oven-aged values in order to determine if the THST caused a colour change on the paper side (i.e. through the paper) above and beyond the Domtar paper colour change. When this was done, only the BEVA 371 samples came close to showing a colour change in the range of 5 ( $4.26 \pm 0.82$ ) and this could have been caused from oven aging above the adhesive's softening point ( $60\text{--}65^\circ\text{C}$ ) causing it to sink into the paper. Frame Sealing Tape FST 1000 and Self-Adhesive Frame Sealing Tape showed a colour change of  $1.39 \pm 0.22$  and  $2.12 \pm 0.38$ , respectively, when the Domtar  $\Delta E$  was subtracted. These could indicate a perceptible colour change. No other product caused a significant colour change through the paper.

Tape side: Oven-aged results are more complicated to evaluate on the tape side as the carriers could be solid, semi-solid, transparent, and semi-transparent. Any colour change of the Domtar paper would be seen through a carrier that was transparent or semi-transparent, but not through the solid or semi-solid carriers. To estimate the colour change for the transparent and semi-transparent carriers, the Domtar tape-side  $\Delta E$  ( $5.91 \pm 0.11$ ) was subtracted for these samples (but not for the solid and semi-solid samples) and highlighted in Table 1 in orange if  $>5$  (i.e. after the subtraction). Results indicate that there are many more products that show a substantial colour change on the tape side compared to the paper side, indicating that the carriers (and/or adhesives) are likely discolouring. A number of the HST made with Kurotani tissue and water-activated paper carriers showed lower colour change values after the above subtraction, indicating less discolouration. Assessing the products for actual light transmission and subtracting the proportional amount of colour change of the Domtar paper would be more accurate than the estimate used above and will be investigated for future colour measurements.

### **Photographic activity test**

The photographic activity test (PAT) (ISO 14523 1999) was used to detect possible chemical interactions between an adhesive or carrier in the THST and photographic material (e.g. silver-gelatin or colour prints, etc.). The PAT consists of incubating the THST ( $70^\circ\text{C}$ , 86% RH for

15 days) in a sandwich against the surface of two sensitive detectors — one for staining and one for image interaction. All tapes were adhered to Whatman #1 filter paper (in the sandwich) and HST heat-set onto the filter paper.

To carry out the test, fading and staining of detectors that had been incubated with the products were compared to those incubated with controls. If the product failed one of the three tests (image interaction, staining, or mottling), then it failed the PAT test.

#### *PAT results*

Results for the PAT are given in Table 1. Of the 42 products tested, only 17 (40%) passed the PAT.

If only the results for the adhesive side are examined (excluding carrier side results):

- The products that contained protein all failed the PAT, except the one that also contained methyl cellulose.
- The product with starch alone passed the PAT.
- The four acrylic poly(*n*-butyl acrylate) (PnBA) products gave different results, two passed and two failed (for different reasons).
- The six acrylic poly(*n*-decyl acrylate) (PnDA) products gave similar results, depending on the additives. If no additive was present, the PnDA product passed the PAT; if polyisobutylene (PIB) was present, it failed due to mottling; if poly(acrylic acid) (PAA) was present, it failed due to mottling and oxidation or reduction of the image.
- Two of the nine acrylic poly(ethylhexyl acrylate) (PEHA) products passed the PAT, while most of the PEHA products that also contained poly(vinyl acetate) (PVAC) (five out of six) failed the PAT due to mottling.
- The acrylic products containing poly(octadecyl acrylate) (PODA) and poly(ethyl acrylate)/poly(methyl methacrylate) (PEA/PMMA) passed the PAT.
- Products containing poly(butyl acrylate)/PMMA (PBA/PMMA) failed the PAT due to oxidation or reduction of the image.
- The two products containing poly(methyl acrylate)/poly(ethyl methacrylate) (PMA/PEMA) gave differing results.
- Finally, products containing rubber and ethylene vinyl acetate (EVA) passed the PAT.

If only the results of the carrier side are examined (excluding the adhesive side results):

- Most of the paper, polyester, polypropylene, poly(vinyl chloride), and cellulose acetate carriers passed the PAT.
- Only about half of the cloth carriers passed.

#### **Removability tests**

For the removability tests, 31 of the 42 products were tested. These were chosen by conservators as products more likely to be in direct contact with paper than others, although a few non-contact products were also included.

For these tests, a strip of the product, either the width of the commercial tape or 2 cm wide, was adhered to two types of paper. The first paper was from two volumes of *Punch* periodicals

dating from 1863 to 1878 (henceforth called “Punch paper”). It is an acidic, smooth, medium-weight, machine-made, woven paper ranging from beige to cream in colour, and was selected to represent a paper that is neither overtly degraded nor robust. The Punch paper had text and cartoons printed in black ink and the tape samples were positioned over these areas. The second paper was a resin-coated Kodak photographic (RC) paper developed in the mid 1970s. (The polyethylene coating on both sides is designed to block the intake of processing chemicals reducing wash times.) The strip of the products was applied to the verso of the photograph.

The water-activated tapes were moistened with distilled water using a sponge and then adhered to the papers using a Roll Down machine (ChemInstruments Inc.) that applied consistent pressure for each sample. The pressure-sensitive tapes were applied to the papers and lightly tacked at the top and bottom of the strip with finger pressure and then adhered along the strip using the Roll Down machine. The Roll Down machine made two passes along each strip. The HST were heat-set as described above using the Dritac Press.

Samples were prepared for NDA and oven aging about 1.5 months before the control and oven-aged sets were assessed for removability.

Five conservators carried out the removability tests. Two types of tests were conducted — mechanical removal and solvent removal. Ease of mechanical removal was assessed using spatulas, heated spatulas, erasers (crepe, vinyl, mechanical pencil), and scalpels (Figure 3). Solvent removal was assessed by immersion (and scraping) with seven solvents — ethanol, acetone, heptane, ethyl acetate, toluene, distilled water, and distilled water brought to a pH of 8.5 with saturated calcium hydroxide solution (Figure 4). For solvent removal, the THST were not assessed for ease of removal, but rather for whether they were completely removed, partially removed, or not removed. Staining of the substrate was also noted.

#### *Mechanical removal*

All five conservators assessed ease of mechanical removal on all selected THST using these definitions.

- **Very Easy (100%):** Carrier and adhesive came off quickly with the same mechanical technique, a large area could be removed easily with a good result, and there was no text loss.
- **Easy (75%):** Carrier came off with only slight adhesive to remove. This removal was not as quick as that above, but a large area could be removed easily with a good result and there was no text loss.
- **Difficult (50%):** These samples required various mechanical techniques (e.g. one mechanical technique for carrier and another for adhesive). Removal was less successful than those above and was assessed as needing some solvent assistance. Also, it was possible to remove only small areas and there was some text loss.
- **Very Difficult (25%):** These samples required various mechanical techniques with less success and were assessed as requiring extensive solvent work. Also, it was possible to remove only small areas and there was text loss.
- **Impossible (0%):** These samples were not removable by any mechanical technique even with solvents.

One point was subtracted from the mechanical score if staining of the substrate following removal was assessed as low, two points if medium, and three points if high.

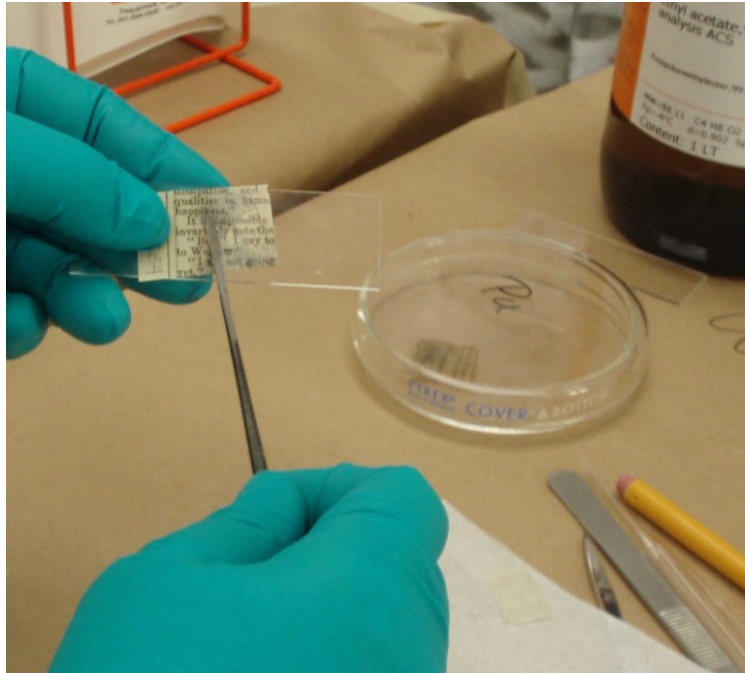


Figure 3. Mechanical removal of tapes from Punch paper and RC paper.

#### *Solvent removal*

Only one conservator assessed removability of the selected THST for each solvent. A score of 100% was assigned if the THST was **totally removed**, 50% if **partially removed**, and 0% if **not removed**.

Three points were subtracted from the solvent removal score if a dark stain remained, two points if slightly stained; and one point if very slightly stained. Thus, if the score in Table 1 is 100 or 50 then there was no staining; if 99 or 49 then there was a very slight stain; if 98 or 48 then there was a slight stain; and if 97 or 47 then there was a definite dark stain.



*Figure 4. Solvent removal of tape from Punch paper. Notice sample in glass Petri dish immersed in solvent waiting to be scraped.*

#### *Removability results*

Removability results for the controls, 1 year NDA, and oven aging are given in Table 1. This table can assist a conservator in deciding what solvents to use to remove a specific product, how difficult that product is to remove mechanically, and if the product gets more difficult or easier to remove after aging.

There are some general trends that can be seen by averaging various results:

- It is more difficult to remove the products from the Punch paper than from the RC paper.
- For the Punch paper, after 1 year of dark aging, the removability scores (all mechanical and solvent scores averaged together) of the products dropped on average by 9 points compared to the controls, and after oven aging they dropped by about 27 points.
- For the RC paper, after 1 year of dark aging, there appears to be no difference in the removability scores (all mechanical and solvent scores averaged together) compared to the controls, but the scores dropped (on average) by about 17 points after oven aging.

After removal of the THST, the substrates were examined by ultraviolet (UV) light to see if any optical brighteners (OB) were transferred from the THST to the substrates. The controls and oven-aged samples showed no transfer of OB.

The Lascaux 360 HV tissues were applied to the substrates in three different ways: as a heat-set tissue, as a pressure-sensitive tissue, and by solvent-reactivation with ethanol. This was done to see if there was any difference in removability after aging. The results, so far, indicate very little difference in removability between the application techniques.

Only a few products showed differences in removability when the pH 8.5 water was used instead of the regular distilled water and these can be seen in Table 1.

During mechanical removal, skinning of the paper substrate, text loss, and amount of adhesive residue remaining were assessed by the conservators. Generally, on removal of the THST, more samples skinned the Punch paper than the RC paper, and adhesive residue was left on more of the Punch samples than on the RC samples. Oven aging almost doubled the number of samples displaying skinning, adhesive residue, and text loss. It must be remembered that text loss was assessed only on the Punch paper as the THST were not applied to text on the RC paper.

The following products showed the least skinning, adhesive residue, and text loss:

- Repa Tex G5
- wheat starch paste tissue
- Document Repair Tape
- Lascaux 360 HV tissue
- Duck Masking Tape
- filmoplast R

The products showing the most skinning, adhesive residue, and text loss were:

- Seal Colormount
- filmoplast P and P90
- Vinamul 3252 tissue
- gudy 831

The remaining products were somewhere in between these groups.

## Discussion

When all the results (pH, colour change, PAT, and the weighted removability score) were evaluated and considered of equal importance (Overall Score, Table 1), the following products fared well:

- water-activated — Repa Tex G5, homemade wheat starch paste, and Gummed Japanese Hinging Paper Hayaku
- pressure-sensitive — filmoplast P and P90, Document Repair Tape, gudy 871, and Duck Masking Tape (Scotch 893 and 3M Magic Removable Tape #811 also fared well, but removability was not tested)
- heat-set — Seal Fusion 4000 Film

In reality, however, the Overall Score might not be the most helpful way to view the results because some properties might be of more importance in particular situations. For instance:

- If an aged known tape needs to be removed from paper, it would be best to go directly to the removability results for the Punch paper.
- If an HST is to be used, the data on the various products would be a good place to start to make a choice.
- If a product is to be used in proximity to a photograph such as sealing case structures, then the PAT results would be of great interest.

In examining the products that were included as token bad case scenarios, the following was found:

- Rubber-based adhesives — Both the Duck Masking Tape and Scotch 893 have done fairly well in the program so far except for discolouration on the tape side, which would be expected with rubber-based products. The discolouration has not penetrated through the Domtar paper to date, but it may be only a matter of time before this happens. These products both passed the PAT and had a neutral pH (control). The Duck Masking Tape required more toxic solvents to remove it, but was fairly removable mechanically.
- PVC Carrier — filmolux 609 did not pass any of the tests (the pH was too low, it produced discolouration on the tape side, and it failed the PAT). Note that removability was not tested.
- SBR/Rosin — Super 77 failed the PAT and needed more toxic solvents to remove it from the two test papers, but the pH (control) was neutral and discolouration has been minimal so far.
- Black Carrier — filmoplast T Tape failed the PAT, but the pH was neutral (removability has not been tested).

## Conclusions

This paper presents considerable data on the pH, colour change, PAT and removability of various THST. However, it must be remembered that testing is still underway and there will be more NDA results to come, which could alter various judgments made here. Also, this study was not designed to identify tape products for direct use on heritage materials, and should not be seen as providing evidence to encourage the use of one product over another as part of a conservation treatment without a case-by-case evaluation. Nevertheless, it is hoped that the information presented will help conservators in their continuing quest to understand the stability, suitability, and removability of these products.

## Acknowledgements

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## Materials and Suppliers

### *BEVA 371 Film 1.0 mil*

Conservator's Products Company  
PO Box 601  
Flanders NJ 17836 USA  
Tel.: 1-973-927-4855  
Website: <http://www.conservators-products.com/>

### *Crompton Tissue, Hinged Cambric Cloth Tape, Lascaux 360 HV/498 HV, Wheat Starch Aytex P, Plextol B500*

Talas  
330 Morgan Avenue  
Brooklyn NY 11211 USA  
Tel.: 1-212-219-0770  
Website: <http://www.talasonline.com>

### *Document Repair Tape and Seal Fusion 4000 Dry Mounting Adhesive Film*

Carr McLean  
461 Horner Avenue  
Toronto ON M8W 4X2 Canada  
Tel.: 1-800-268-2123  
Website: <http://www.carrmclean.ca>

### *Double-Coated Film Tape #415, Scotch Magic Tape #810, Scotch Magic Removable Tape #811, Scotch Adhesive Transfer Tape #924, Acid-free Double-Stick Adhesive Pen #007, Spray Adhesive Super 77, Photo & Document Mending Tape #001, Scotch 893*

3M  
Building 17, 10746 Innovation Road  
Cottage Grove MN 55016-4600 USA  
Tel.: 1-651-458-2047  
Website: [http://solutions.3m.com/wps.portal/3M/en\\_US/CottageGrove/Plant/](http://solutions.3m.com/wps.portal/3M/en_US/CottageGrove/Plant/)

### *Duck General Purpose Masking Tape*

Canadian Tire  
Ogilvie Road  
Ottawa ON Canada  
Tel.: 613-748-0637  
Website: <http://www.canadiantire.ca>

### *filmoplast P, P90, R, SH and T, filmomatt libre, filmolux 609, gudy 831 and 871*

Neschen AG  
Hans-Neschen-Str.1  
31675 Bückebug Germany  
Tel.: +49 (0) 5722-20 70  
Website: <http://www.neschen.com>

### *Frame Sealing Tape FST 1000*

Gaylord  
PO Box 4901  
Syracuse NY 13221-4901 USA  
Tel.: 1-800-448-6160 or 1-315-634-8221  
Website: <http://www.gaylord.com>

### *Gummed Paper Hinging Tape, Gummed Japanese Hinging Paper Hayaku, Gummed Linen Hinging Tape, Self-Adhesive Linen Hinging Tape, White Foil Back Frame Sealing Tape, Perforated White Linen Tape*

Lineco (a Division of University Products)  
Tel.: 1-800-322-7775

E-mail: [info@lineco.com](mailto:info@lineco.com)

or

University Products Inc.  
517 Main Street  
Holyoke MA 01040 USA  
Tel.: 1-800-628-1912, 1-413-532-3372  
E-mail: [info@universityproducts.com](mailto:info@universityproducts.com) or  
[custserv@universityproducts.com](mailto:custserv@universityproducts.com)

### *Kurotani #16 Small Tissue*

The Japanese Paper Place  
77 Brock Avenue  
Toronto ON M6K 2L3 Canada  
Tel.: 416-538-9669  
Fax: 416-538-0563  
E-mail: [washi@japanesepaperplace.com](mailto:washi@japanesepaperplace.com)  
Website: <http://www.japanesepaperplace.com/>

### *PH7-70 Conservation ATG Tape Permanent, Gummed Linen Tape*

UK Industrial Tapes  
Brumwell House, Westway Industrial Estate  
Throckley Newcastle Upon Tyne NE15 9HW UK  
Tel.: 0191 269 7810  
Website: <http://www.ukindustrialtapes.co.uk>

### *Repatex G5*

Gabi Kleindorfer  
Aster Strasse 9, D-84186, Vilsheim  
Tel.: 49 8706 1094  
Website: <http://www.gmw-shop.de/shop/japanpapier---repatex/repatex/repatex-g5.php>

### *Rhoplex AC-73*

Museum Services Corporation  
South Saint Paul MN USA  
Tel.: 651-450-8954  
Website:  
<http://www.museumservicescorporation.com/>

### *Seal Colormount Dry Mounting Tissue (SEC111425)*

B&H Photovideo Pro Audio  
Website: <http://www.bhphotovideo.com/>

### *Unsupported Archibond*

Conservation Resources International  
Unit 2, Ashville Way, Off Watlington Road  
Cowley Oxford OX4 5TU England  
Tel.: +44 (0) 1865 747755  
Website: <http://www.conservationresources.com/>

*Framer's Tape II #S2000*

Dick Blick Art Materials  
PO Box 1267  
Galesburg IL 61402-1267 USA  
Tel.: 1-800-828-4548  
Website: <http://www.dickblick.com>

*Vinamul 3252*

Celanese Emulsions GmbH  
Industriepark Höchst, Building E-416  
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Tel.: 069 305 17701  
Website: <http://www.celanese.com/htm>

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**Kate Westbury** graduated from Queen's University in Kingston, Ontario in 1997, where she earned a BA Honours in History and Geography. She continued her studies at Fleming College in Peterborough, Ontario, graduating from the Collections Conservation and Management program in 2001. Kate has worked as a conservator in Ottawa, Ontario since that time, participating in significant conservation projects with the Canadian Conservation Institute (CCI), the Senate of Canada, the House of Commons, and the Supreme Court of Canada. She has also acted as the course director for the Ontario Museum Association course *Artifacts* and instructed conservation students in the Applied Museum Studies program at Algonquin College of Applied Arts and Technology in Ottawa. She is currently employed as a conservator in the Paper Lab at the Parks Canada Ontario Service Centre in Ottawa.

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**Elissa O'Loughlin** obtained a BFA from Moore College of Art and Design in Philadelphia, Pennsylvania in 1975. She worked as a conservator at the United States National Archives in Washington, DC from 1983 until 2000, when she joined the staff of the Walters Art Museum in Baltimore, Maryland as Senior Paper Conservator. She has developed and taught the 5-day class *Removal of Pressure Sensitive Tape and Tape Stains* at numerous venues over the past 16 years.

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**Kate Westbury** a obtenu un diplôme (B.Sc. avec distinction en histoire et en géographie) de l'Université Queen's de Kingston, en Ontario, en 1997. Elle a poursuivi ses études au Sir Sandford Fleming College de Peterborough (Ontario), où elle a obtenu un diplôme en 2001, dans le cadre du programme de conservation et de gestion des collections de l'institution. Depuis lors, M<sup>me</sup> Westbury travaille comme restauratrice à Ottawa et participe à de nombreux projets d'envergure avec l'Institut canadien de conservation (ICC), le Sénat du Canada, la Chambre des communes et la Cour suprême du Canada. Elle a occupé le poste de directrice de programme des cours « *Artifacts* » de l'Association des musées de l'Ontario, et a aussi enseigné à des étudiants en conservation, dans le cadre du programme d'études muséales appliquées du Collège Algonquin des arts appliqués et de technologie d'Ottawa. M<sup>me</sup> Westbury occupe présentement un poste de restauratrice au sein du laboratoire de conservation et de restauration d'œuvres sur papier du Centre de services de l'Ontario de Parcs Canada, à Ottawa.

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**R. Scott Williams** has been an analytical chemist and Conservation Scientist at the Canadian Conservation Institute since 1977. He has performed thousands of analyses of materials from all types of museum and cultural objects: paintings, paper, textiles, and ethnographic and archaeological objects. He has a particular interest in plastics, particularly the degradation, interaction, and conservation of museum objects and storage materials composed of plastics and other synthetic materials. His current work includes the development of portable mid and near infrared (IR) spectroscopy to carry out non-destructive on-site chemical analysis of objects at heritage institutions. Scott has published or presented more than 80 papers for conservation, museum, and scientific professionals.

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**Joe Iraci** is a Senior Conservation Scientist in the Conservation Research division at the Canadian Conservation Institute, and has been performing research studies on electronic media for the past 14 years. His research work includes examining the stability and degradation of CD and DVD formats as well as other materials such as magnetic tape, and investigating the disaster recovery of these materials. Joe has delivered many workshops across Canada, teaching participants from archives, libraries, and museums about the preservation of electronic media.

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Table 1. Results of the chemical analysis, pH, colour change, PAT, and removability test for the THST.

THST (Heat-set Temperatures)	Chemical Analysis*	pH (pH Kurotani Tissue alone = 7.18±.02) pH 6-8; <6 or >8		Colour Change (Domtar Paper alone: ΔE=5.91±.11 Tape Side; ΔE=6.57±.07 Paper Side) (large change)			PAT (Pass ; Fail)			Removability (For Mechanical >70 is easier to remove; 40-69 more difficult; <39 very difficult. For Solvent 97-100 is removable; 47-50 is partially removable; 0 is not removable) (PU=Punch Paper; RC=RC paper) (AGE - C=Controls; 1=1 year dark aging; O=Oven Aging) (Staining: L=low; M=medium; H=high)										Overall Score (all tests equal)‡											
		THST Alone	THST w Kurotani	Transparency†	ΔE Tape Side	ΔE Paper Side	Adhesive Side	Carrier Side	Overall PAT	PU or RC	AGE	Mechanical	Water	pH 8.5 Water	Ethanol	Acetone	Heptane	Ethyl Acetate	Toluene												
<b>WATER-ACTIVATED</b>																															
<b>Paper Carriers</b>																															
Gummed Paper Hinging Tape	Protein	7.24±.03		ST- S	3.79±.22	5.63±.20	F	F	F	PU	C	75	100	100	0	0	0	0	0	62											
											1	75	100	100	49	0	0	0	0												
											O	43M	47	47	0	0	0	0	0												
										RC	C	80	100	100	0	0	0	0	0												
											1	74 L	100	100	0	0	0	0	0												
											O	70	100	100	0	0	0	0	0												
										Repa Tex G5	Protein + methyl cellulose	7.71±.20		ST	8.85±.50	6.89±.29	P	P	P		PU	C	95	100	100	50	100	100	100	0	96
																						1	85	100	100	49	100	100	0	0	
																						O	100	100	100	50	50	100	0	0	
RC	C	100	100	100	100	100	100	100	0																						
	1	85	100	100	100	100	100	0	47																						
	O	100	100	100	100	100	0	100	0																						
Gummed Japanese Hinging Paper Hayaku	PVOH/PVAC	6.98±.04		ST	6.60±.29	6.21±.06	P	P	P											PU	C	50	100	100	100	100	0	100	100	90	
																					1	35	100	100	100	100	50	100	100		
																					O	20	0	0	0	100	0	98	100		
										RC	C	90	100	100	50	100	0	100	100												
											1	85	100	100	50	100	50	100	100												
											O																				

										O	40	50	50	50	100	0	100	100		
Homemade Wheat Starch Paste <i>with Kurotani Tissue</i>	Starch	6.04±.04	7.01±.05	ST	6.15±.46	6.05±.29	P		P	PU	C	100	100	100	100	100	100	100	100	95
											1	95	100	100	99	97	100	100	100	
											O	90	100	100	100	100	100	100	99	
										RC	C	100	100	100	0	50	50	0	0	
											1	75	100	100	50	50	100	50	0	
											O	100	100	100	0	50	50	50	0	
<b>Cloth Carriers</b>																				
Hinged Cambric Cloth Tape	Protein+Starch >8:1	6.78±.02		SS	7.71±.25	5.98±.51	F	F	F	removability not done									50	
Gummed Linen Hinging Tape	Protein+Starch >8:1 (carrier slightly different)	7.57±.10		SS	3.89±.16	5.98±.17	F	F	F	PU	C	90	100	100	100	50	100	100	100	67
											1	50	100	100	100	0	0	0	50	
											O	80	100	100	0	50	50	100	100	
										RC	C	90	100	100	0	0	0	99	0	
											1	80	100	100	100	50	0	0	50	
											O	75	100	100	0	0	0	0	0	
Perforated White Linen Tape	Protein+Starch >8:1	8.12±.01		SS	5.49±.25	5.82±.17	F	F	F	PU	C	85	100	100	0	0	0	0	50	28
											1	70	100	100	100	100	100	100	50	
											O	65	0	0	0	0	0	0	48	
										RC	C	90	100	100	0	0	0	0	0	
											1	90	100	100	48	100	100	100	100	
											O	75	100	100	0	100	0	50	0	
Gummed Linen Tape	Modified Starch (carrier different)	6.43±.04		SS	2.98±.16	5.93±.15	F	P	F	removability not done									67	
<b>PRESSURE-SENSITIVE</b>																				
<b>Paper Carriers</b>																				
filmoplast P	PnBa+CaCO <sub>3</sub> +UN	7.06±.11		ST	11.14±.25	6.67±.23	P	P	P	PU	C	45	50	50	100	99	99	100	100	73
											1	49 L	100	100	48	100	50	100	100	
											O	25	0	0	0	0	50	99	99	
										RC	C	75	100	50	0	0	100	100	100	
											1	70	100	100	0	0	50	50	0	
											O	70	100	100	0	0	50	50	0	

										O	65	50	50	0	0	50	100	100											
filmoplast P90	PEHA+CaCO3	6.93±.07		ST	7.94±.15	5.99±.18	P	P	P	PU	C	55	0	0	0	100	100	100	100	85									
											1	50	0	0	98	50	50	100	100										
											O	25	0	0	0	0	0	50	100										
										RC	C	75	100	100	100	100	100	100	100										
											1	60	100	100	100	50	50	100	100										
											O	50	0	48	50	49	100	100	100										
gudy 831 <i>with Kurotani Tissue</i>	PEHA+PVAC+so ap	7.16±.13		ST	10.66±.44	6.65±.20	F		F	PU	C	60	0	50	0	100	100	100	100	49									
											1	48 M	0	0	98	50	99	100	50										
											O	28 M	0	0	0	99	50	48	99										
										RC	C	85	100	100	50	100	100	100	100										
											1	60	100	100	50	100	100	100	100										
											O	75	0	0	50	99	100	100	100										
DocumentRepair Tape	PVAC-vinyl maleate	7.35±.08		ST	11.74±.47	6.50±.09	P	P	P	PU	C	90	0	0	100	100	100	100	100	81									
											1	74 L	0	0	98	100	100	100	100										
											O	53 M	0	0	98	99	50	98	100										
										RC	C	90	100	100	100	100	100	100	100										
											1	85	100	100	100	100	100	100	100										
											O	69 L	100	100	100	100	100	100	100										
Duck General Purpose Masking Tape	Rubber + Tackifier (carrier with acrylic coating)	6.64±.03		ST	16.90±.25	6.97±.53	P	P	P	PU	C	75	0	0	0	100	100	100	100	77									
											1	70	0	0	100	50	100	100	100										
											O	47 H	0	0	47	97	50	97	97										
										RC	C	85	100	100	100	50	100	100	100										
											1	85	100	100	100	100	100	100	100										
											O	70	0	0	50	0	50	100	100										
<b>Cloth Carriers</b>																													
filmoplast SH	PEHA + PVAC	6.12±.03		SS	6.99±.13	6.75±.10	F	F	F	PU	C	70	50	50	100	100	100	100	100	51									
											1	64 L	0	0	98	50	100	100	100										
											O	25	0	0	47	98	99	100	100										
										RC	C	75	100	100	100	100	100	100	100										



										1	90	100	100	100	100	50	50	50			
										O	75	100	100	100	50	100	100	100			
<b>Poly(vinyl chloride) (PVC) Carriers</b>																					
filmolux 609	PEHA + PVAC + PH PVC Carrier	5.61±.05		T	16.93±.29	6.97±.16	F	P	F		removability not done								17		
<b>Cellulose Acetate Carrier</b>																					
3M Magic Tape #810	PnDA	5.45±.26		T	11.44±.17	6.60±.19	P	P	P	PU	C	100	0	0	100	100	100	100	100	50	
											1	60	0	0	98	100	100	50	100		
											O	38 M	0	0	48	47	98	98	98		
											RC	C	100	100	100	100	100	50	50		100
												1	55	100	100	50	100	100	50		100
												O	89 L	0	0	50	100	50	50		97
3M Magic Removable Tape #811	PnDA	6.93±.06		T	11.68±.31	6.36±.18	P	P	P		removability not done								83		
<b>Foil Carriers</b>																					
Frame Sealing Tape FST 1000	PnBA	8.23±.08		S	4.13±.19	7.96±.21	P	F	F		removability not done								33		
Self-Adhesive Frame Sealing Tape (White)	PEHA	7.94±.06		S	4.74±.20	8.69±.37	F	P	F		removability not done								50		
<b>No Carrier</b>																					
3M Adhesive Transfer Tape #924 <i>with Kurotani Tissue</i>	PnDA + sm PAA	6.29±.08		ST	10.51±.39	7.23±.15	F		F		removability not done								50		
Acid-Free Db-Stick Adhesive Pen #007 <i>with Kurotani Tissue</i>	PnDA + PIB ++	7.95±.19		ST	6.10±.34	6.78±.27	F		F		removability not done								67		
PH7-70 Conservation ATG Tape Permanent <i>with Kurotani Tissue</i>	PEHA + UN	6.52±.13		ST	19.17±1.80	7.19±.19	F		F	PU	C	75	50	50	0	100	100	98	99	51	
											1	63 M	0	0	50	100	99	100	100		
											O	43 M	47	47	0	47	97	97	97		
											RC	C	95	100	100	50	100	100	100		100
												1	75	100	100	48	100	100	100		100
												O	74 L	48	50	47	97	97	98		98
gudy 871 <i>with Kurotani Tissue</i>	PEHA + PVAC + soap	7.29±.12		ST	7.72±.23	5.63±.12	P		P	PU	C	44 L	50	50	100	100	100	100	100	88	
											1	49 L	0	0	48	100	100	50	100		



											1	24 L	0	0	0	0	50	0	0	62	
											O	25	0	0	0	0	100	0	0		
Vinamul 3252 <i>with Kurotani Tissue</i> (78-81°C)	VAE + VAL/VAC + NaCMC	6.71±.19	7.70±.11	ST	6.44±.29	5.80±.19	F	F	F	F	F	PU	C	45	50	50	0	100	0	100	99
													1	30	0	0	100	100	0	50	50
													O	32 H	0	0	0	0	0	98	99
												RC	C	70	100	100	50	100	100	100	100
													1	95	100	100	50	100	0	100	50
													O	35	100	100	0	100	0	100	100
LoC HST (Plextol B500, Rhoplex AC-73, water) <i>with Kurotani Tissue</i> (86-91°C)	PEA/PMMA	4.90±.11	7.01±.01	ST	8.09±.33	6.12±.36	P	P	P	P	P	PU	C	70	100	100	100	100	100	100	100
													1	55	50	50	100	100	0	100	100
													O	60	100	100	100	100	0	100	100
												RC	C	90	100	100	100	100	100	100	100
													1	95	100	100	50	100	100	100	50
													O	60	0	0	100	100	100	100	100
Lascaux 498 HV <i>with Kurotani Tissue</i> (72-77°C)	PBA/PMMA	7.29±.11	7.09±.09	ST	9.79±2.44	6.88±.59	F	F	F	F	F	PU	C	49 L	0	0	100	100	0	100	100
													1	40	0	0	100	50	0	100	100
													O	35	0	0	100	100	0	100	98
												RC	C	100	100	100	100	100	100	100	100
													1	80	100	100	50	100	0	100	100
													O	45	50	50	100	100	0	100	100
Lascaux 360 HV <b>MADE AS HEAT-SET TISSUE</b> <i>with Kurotani Tissue</i> (48-51°C)	PBA/PMMA	6.87±.04	7.38±.04	ST	9.92±.89	6.43±.22	F	F	F	F	F	PU	C	80	0	0	100	100	50	100	100
													1	49 L	0	0	100	100	0	100	100
													O	53 M	0	0	48	100	50	100	99
												RC	C	85	100	100	100	100	100	100	100
													1	80	100	100	100	100	0	100	100
													O	80	50	50	100	100	50	100	100
Lascaux 360 HV <b>MADE AS PRESSURE-SENSITIVE TISSUE</b> <i>with Kurotani Tissue</i>	PBA/PMMA	"	"	"	"	"	"	"	"	"	"	PU	C	49 L	0	0	100	100	0	100	100
													1	44 L	0	0	100	100	0	100	100
													O	48 M	0	0	98	100	0	99	99
												RC	C	88	100	100	100	100	0	100	100

											1	95	100	100	100	100	0	100	100	65	
											O	88	50	50	100	100	0	100	100		
Lascaux 360 HV <b>MADE BY SOLVENT REACTIVATION WITH ETHANOL</b> <i>with Kurotani Tissue</i>	PBA/PMMA	"	"	"	"	"	"	"	"	"	PU	C	63	0	0	100	100	100	100	100	65
												1	49 L	0	0	100	100	0	100	100	
												O	49 L	0	0	99	99	0	99	99	
											RC	C	88	100	100	100	100	0	100	100	65
												1	95	100	100	100	100	0	100	100	
												O	75	50	50	100	100	0	100	100	
Lascaux 498/360 (2:1) <i>with Kurotani Tissue</i> (55-60°C)	PBA/PMMA	6.78±.01	7.29±±.0 6	ST	8.44±.63	7.05±.27	F	F	F	PU	C	69 L	0	0	100	100	100	100	100	65	
											1	49 L	0	0	100	98	0	100	100		
											O	43 M	0	0	100	100	0	100	100		
										RC	C	90	100	100	100	100	100	100	100	65	
											1	80	100	100	100	100	0	100	100		
											O	80	0	0	100	100	100	100	100		
BEVA 371 Film 1 mil <i>with Kurotani Tissue</i> (60-62°C)	EVA + KRN ++	6.73±.21		ST	16.60±.39	10.83±.8 2	P	P	P	PU	C	48 M	0	0	100	100	100	97	100	65	
											1	48 M	0	0	100	100	100	50	100		
											O	48 M	47	47	97	47	47	97	100		
										RC	C	90	100	100	100	100	100	100	100	65	
											1	80	100	100	50	100	100	100	100		
											O	84 L	0	100	100	100	100	100	100		
Seal Fusion 4000 Dry Mounting Adhesive Film <i>with Kurotani Tissue</i> (74-80°C)	EVA	7.11±.18		ST	7.54±.47	6.47±.26	P	P	P	PU	C	60	50	50	0	0	50	48	100	85	
											1	38 L	0	0	50	0	0	0	50		
											O	47 H	48	48	0	0	0	0	98		
										RC	C	95	100	100	100	100	100	100	100	85	
											1	95	100	100	100	100	100	100	100		
											O	64 L	0	0	100	0	100	50	100		
Unsupported Archibond <i>with Kurotani Tissue</i>	PMA/PEMA	5.06±.08		ST	7.00±.17	6.73±.11	P	P	P	PU	C	50	50	50	99	100	50	98	100	66	
											1	44 L	100	100	100	100	0	100	98		
											O	43 M	48	48	99	99	49	98	99		
										RC	C	90	100	100	100	100	50	100	100	66	

